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The Medicinal Flora of Sambalpur District, Orissa, India

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Abstract: This paper describes an analysis of the plants of Sambalpur district of Orissa, India which have been used medicinally by local people. The families having medicinal values are analysed using Moerman's method of regression analysis. There were 136 plant families recorded from the study area. The analysis of families showed that the Euphorbiaceae family being used most ethnomedicinally by the local people in Sambalpur district of Orissa, whereas Poaceae is used least one. This type of study determines the degree of importance of plant families in the medicinal flora of the region.

Key words: Medicinal flora; Orissa; Regression analysis; Sambalpur district
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1 Introduction

Research on medicinal and other useful plants used in indigenous societies has been driven by two harmonizing interests: The use of such information for discovery of 'new' bioactive natural products derived from plants and the use of plant extracts in primary health care (Heinrich and Gibbons, 2001) and the interest in better understanding the anthropological basis, if possible on a cross-cultural basis, of the use of these resources by humans and particularly on the rationale behind the selection of these resources (Moerman *et al.*, 1999; Leonti *et al.*, 2003). Moerman (1996) and his colleagues have developed and used a method which allows for a statistical analysis of ethnobotanical information based on that the number of medicinally used plant taxa and the total number of taxa in a certain region is known. Similar kind of study was undertaken in Sambalpur district of Orissa to analyse the use of plants for medical purpose by certain indigenous tribal group.

The Sambalpur district of located in northwestern portion of Orissa, lies between 22°11′ and 23°34′ N latitudes and 82°39′ and 85°15′ E longitudes. Earlier it was the second largest district in Orissa, but later the district was divided into four districts such as Sambalpur, Jharsuguda, Bargarh and Deogarh (Fig. 1). The study was conducted in all the four districts. It spread over an area of 17 515 km^2 which is 11.25% of the state's area with 5 822 km^2 forest area (Anonymous, 2003). The district has a luxuriant forest cover with numerous hill ranges. The hills, with their innumerable crests and valleys, interspersed with countless streams and rivers exhibit a great degree of topographic variation, ranging from 300 to 985 m above sea level. The entire drainage system in the district is shared by two rivers, Mahanadi and Brahmani and their tributaries. Geological formation of the region consists of submetamorphic sandstones, quartzite and khondalites (Pandey and Chatterjee, 1984). The soil of this area is mostly red-laterite. Some southern part of the district also experiences black-cotton soil. The climate of the area

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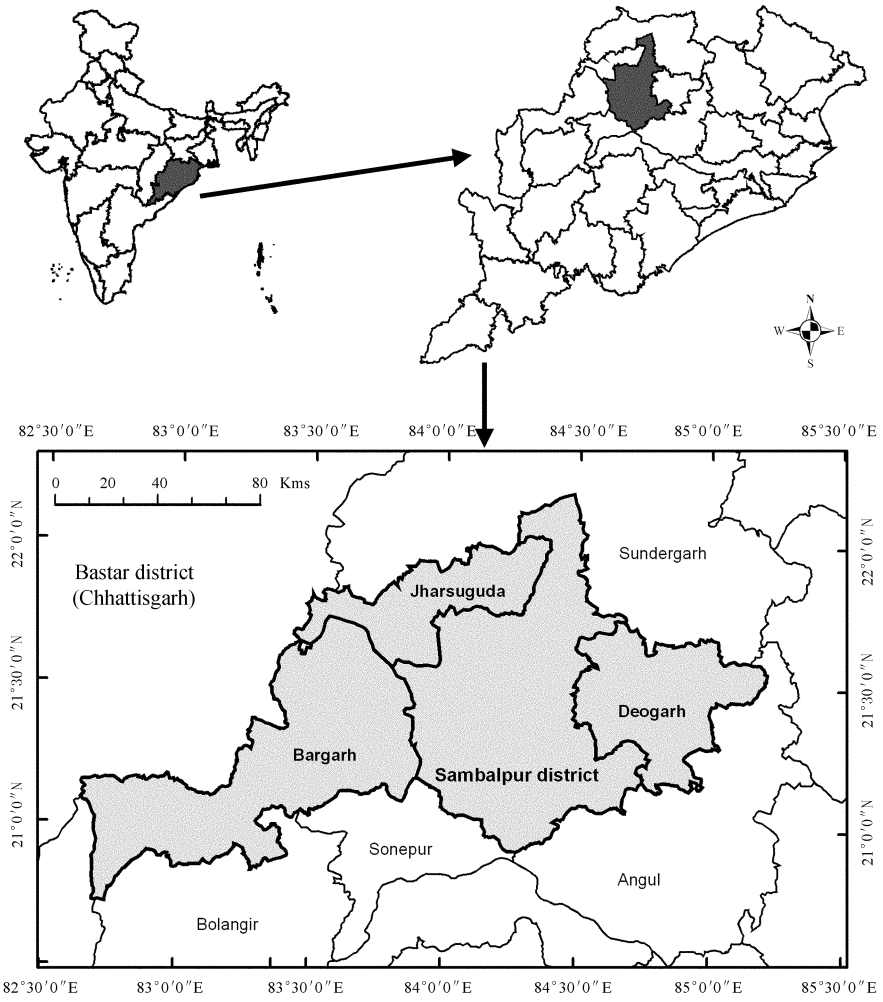

Fig. 1 Location map of Sambalpur district, Orissa

is hot, dry and humid in summer, a restricted rainy season and a moderate winter. The average daily minimum and maximum temperature is 14℃ and 42℃ respectively. May is considered the hottest month and December is the coldest month. About 90% of the rainfall is received from the south-west monsoon. The mean annual rainfall in the district is 142.3 cm with an average of 72 rainy days (Senapati and Mohanti, 1971). The relative humidity generally maintained over 75% during the monsoon months. The flora of Sambalpur district with economically useful plants has recently been described by Panda and Das (2004) while the medicinally useful plants of the region have been described in various research papers (Haines, 1921—1925; Raju, 1960; Panigrahi, 1963; Pradhan and Dash, 1984; Brahmam and Saxena, 1989; Brahmam and Saxena, 1990; Panda and Das, 1995; Saxena and Brahmam, 1995). The present study was undertaken to determine the degree of importance of plant families in the medicinal flora of the region.

2 Materials and Methods

The medicinal uses of plants recorded from various sources have listed (Table 1). Several field trips were conducted during 2004—2006 to enlist the medicinal plant species. The field trip resulted in the collection of information regarding use of plant species for various ailments. The plants have been arranged in families ac-

cording to Bentham and Hooker system of classification. The nomenclature has been based on the most recent work in the geographic area by Panda and Das (2004). Using the method of regression and residual analysis described by Kapur *et al*. (1992) and Girach *et al*. (1999) in India, a regression analysis was carried out on the number of medicinal species per family (MS) against the total number of species in each family (TS) for the 136 flowering plant families in Sambalpur flora. The regression equation $Y=a+bx$ is worked out after finding the values of constants a and b as described by Gupta (1985). The regression equation is

MS=1.10+0.33 * TS

According to this equation and under the null hypothesis (essentially saying that the selection of medicinal plants is random) the number of medicinal species per family should be equal to the total number of species in the family times 0.33 plus 1.10. These predicted values are shown in Table 1. Subtracting the predicted value from the actual value gives us the residual value for each data point. The residuals are also shown in Table 1; the families have been ranked accordingly from the highest positive residual to the lower negative residual in descending order. The difference recorded by comparison between similar studies conducted on the floras of Jammu and Kashmir and Similipahar are tabulated in Table 2. The data are shown in Fig. 2, where the points plotted are the actual values of the number of total species and medicinal species in each family. The residual value may be visualized as the vertical distance from the data point to regression line. Residuals above the lines are positive while those below the lines are negative. Some of the families discussed in the text are labeled.

Table 1 Regression analysis of 136 Sambalpur (Orissa) plant families

Rank	Family	Total species (TS)	Medicinal species (MS)	Predicted values	Residual values	Rank	Family	Total species (TS)	Medicinal species (MS)	Predicted values	Residual values
1	Euphorbiaceae	40	27	14.3	12.7	28	Zingiberaceae	5	4	2.8	1.3
2	Caesalpiniaceae	18	16	7.0	9.0	29	Bignoniaceae	6	4	3.1	0.9
3	Malvaceae	15	15	6.1	9.0	30	Flacourtiaceae	3	3	2.1	0.9
4	Verbenaceae	16	15	6.4	8.6	31	Menispermaceae	3	3	2.1	0.9
5	Papilionaceae	62	30	21.6	8.4	32	Sapindaceae	3	3	2.1	0.9
6	Apocynaceae	11	11	4.7	6.3	33	Sapotaceae	3	3	2.1	0.9
7	Asclepiadaceae	11	11	4.7	6.3	34	Smilacaceae	3	3	2.1	0.9
8	Rubiaceae	25	14	9.4	4.7	35	Boraginaceae	7	4	3.4	0.6
9	Cucurbitaceae	8	8	3.7	4.3	36	Tiliaceae	5	3	2.8	0.3
10	Amaranthaceae	15	10	6.1	4.0	37	Balsaminaceae	2	2	1.8	0.2
11	Solanaceae	7	7	3.4	3.6	38	Barringtoniaceae	2	2	1.8	0.2
12	Sterculiaceae	7	7	3.4	3.6	39	Capparaceae	2	2	1.8	0.2
13	Mimosaceae	14	9	5.7	3.3	40	Celastraceae	2	2	1.8	0.2
14	Moraceae	12	8	5.1	2.9	41	Cordiaceae	2	2	1.8	0.2
15	Combretaceae	6	6	3.1	2.9	42	Dilleniaceae	2	2	1.8	0.2
16	Dioscoreaceae	6	6	3.1	2.9	43	Ebenaceae	2	2	1.8	0.2
17	Lamiaceae	16	9	6.4	2.6	44	Loranthaceae	2	2	1.8	0.2
18	Acanthaceae	32	14	11.7	2.3	45	Myrsinaceae	2	2	1.8	0.2
19	Anacardiaceae	5	5	2.8	2.3	46	Oxalidaceae	2	2	1.8	0.2
20	Arecaceae	5	5	2.8	2.3	47	Pedaliaceae	2	2	1.8	0.2
21	Liliaceae	5	5	2.8	2.3	48	Piperaceae	2	2	1.8	0.2
22	Rhamnaceae	5	5	2.8	2.3	49	Strychnaceae	2	2	1.8	0.2
23	Rutaceae	5	5	2.8	2.3	50	Viscaceae	2	2	1.8	0.2
24	Anonaceae	4	4	2.4	1.6	51	Bombacaceae	3	2	2.1	-0.1
25	Myrtaceae	4	4	2.4	1.6	52	Melastomataceae	3	2	2.1	-0.1
26	Ulmaceae	4	4	2.4	1.6	53	Meliaceae	3	2	2.1	-0.1
27	Vitaceae	4	4	2.4	1.6	54	Nymphaeaceae	3	2	2.1	-0.1

Continue table 1

Rank	Family	Total species (TS)	Medicinal species (MS)	Predicted values	Residual values	Rank	Family	Total species (TS)	Medicinal species (MS)	Predicted values	Residual values
55	Araceae	7	3	3.4	-0.4	96	Nyctaginaceae	2	1	1.8	-0.8
56	Urticaceae	4	2	2.4	-0.4	97	Portulacaceae	2	1	1.8	-0.8
57	Alangiaceae	1	1	1.4	-0.4	98	Oleaceae	3	1	2.1	-1.1
58	Aristolochiaceae	1	1	1.4	-0.4	99	Convolvulaceae	16	5	6.4	-1.4
59	Averrhoeaceae	1	1	1.4	-0.4	100	Aizoaceae	4	1	2.4	-1.4
60	Basellaceae	1	1	1.4	-0.4	101	Areceae	1	0	1.4	-1.4
61	Begoniaceae	1	1	1.4	-0.4	102	Bromeliaceae	1	0	1.4	-1.4
62	Brassicaceae	1	1	1.4	-0.4	103	Casurinaceae	1	0	1.4	-1.4
63	Burseraceae	1	1	1.4	-0.4	104	Crassulaceae	1	0	1.4	-1.4
64	Cactaceae	1	1	1.4	-0.4	105	Ehretiaceae	1	0	1.4	-1.4
65	Cannaceae	1	1	1.4	-0.4	106	Hydrophyllaceae	1	0	1.4	-1.4
66	Caricaceae	1	1	1.4	-0.4	107	Hypericaceae	1	0	1.4	-1.4
67	Chenopodiaceae	1	1	1.4	-0.4	108	Juncaceae	1	0	1.4	-1.4
68	Dipterocarpaceae	1	1	1.4	-0.4	109	Lemnaceae	1	0	1.4	-1.4
69	Elatinaceae	1	1	1.4	-0.4	110	Pistiaceae	1	0	1.4	-1.4
70	Gesneriaceae	1	1	1.4	-0.4	111	Ranunculaceae	1	0	1.4	-1.4
71	Hypoxidaceae	1	1	1.4	-0.4	112	Ruppiaceae	1	0	1.4	-1.4
72	Lauraceae	1	1	1.4	-0.4	113	Sagittariaceae	1	0	1.4	-1.4
73	Leeaceae	1	1	1.4	-0.4	114	Typhaceae	1	0	1.4	-1.4
74	Magnoliaceae	1	1	1.4	-0.4	115	Vallisneriaceae	1	0	1.4	-1.4
75	Moringaceae	1	1	1.4	-0.4	116	Xyridaceae	1	0	1.4	-1.4
76	Musaceae	1	1	1.4	-0.4	117	Cuscutaceae	2	0	1.8	-1.8
77	Nyctanthaceae	1	1	1.4	-0.4	118	Droseraceae	2	0	1.8	-1.8
78	Olacaceae	1	1	1.4	-0.4	119	Eriocaulaceae	2	0	1.8	-1.8
79	Orobanchaceae	1	1	1.4	-0.4	120	Menyanthaceae	2	0	1.8	-1.8
80	Pandanaceae	1	1	1.4	-0.4	121	Potamogetonaceae	2	0	1.8	-1.8
81	Papaveraceae	1	1	1.4	-0.4	122	Hydrocharitaceae	3	0	2.1	-2.1
82	Passifloraceae	1	1	1.4	-0.4	123	Lentibulariaceae	3	0	2.1	-2.1
83	Plumbaginaceae	1	1	1.4	-0.4	124	Onagraceae	3	0	2.1	-2.1
84	Punicaceae	1	1	1.4	-0.4	125	Polygalaceae	3	0	2.1	-2.1
85	Santalaceae	1	1	1.4	-0.4	126	Pontederiaceae	3	0	2.1	-2.1
86	Simaroubaceae	1	1	1.4	-0.4	127	Spigeliaceae	3	0	2.1	-2.1
87	Symplocaceae	1	1	1.4	-0.4	128	Campanulaceae	4	0	2.4	-2.4
88	Tamaricaceae	1	1	1.4	-0.4	129	Polygonaceae	4	0	2.4	-2.4
89	Violaceae	1	1	1.4	-0.4	130	Gentianaceae	5	0	2.8	-2.8
90	Lythraceae	11	4	4.7	-0.7	131	Asteraceae	37	10	13.3	-3.3
91	Apiaceae	5	2	2.8	-0.8	132	Orchidaceae	11	1	4.7	-3.7
92	Agavaceae	2	1	1.8	-0.8	133	Commelinaceae	12	1	5.1	-4.1
93	Amaryllidaceae	2	1	1.8	-0.8	134	Scrophulariaceae	20	2	7.7	-5.7
94	Caryophyllaceae	2	1	1.8	-0.8	135	Cyperaceae	37	1	13.3	-12.3
95	Cleomaceae	2	1	1.8	-0.8	136	Poaceae	63	2	21.9	-19.9

3 Results and Discussion

The regression analysis showed the residual values range from 12.7 to −19.9 (Table 1). Families with large positive residuals are the ones used more often than chance alone would allow, while families with large negative values are used less than chance would allow. Among families (Rank 1 to 50) with larger than expected number of medicinals are Euphorbiaceae, Caesalpiniaceae, Malvaceae, Papilionaceae and Apocynaceae. Among the families (Rank 51 to 136) with fewer than expected number of medicinals are Poaceae, Cyperaceae, Scrophulariaceae, Commelinaceae and Orchidaceae.

Comparing the present data with two different study sites (Jammu and Kashmir and Similipahar, Orissa), it shows marked differences between the medicinal floras of these areas (Table 2).

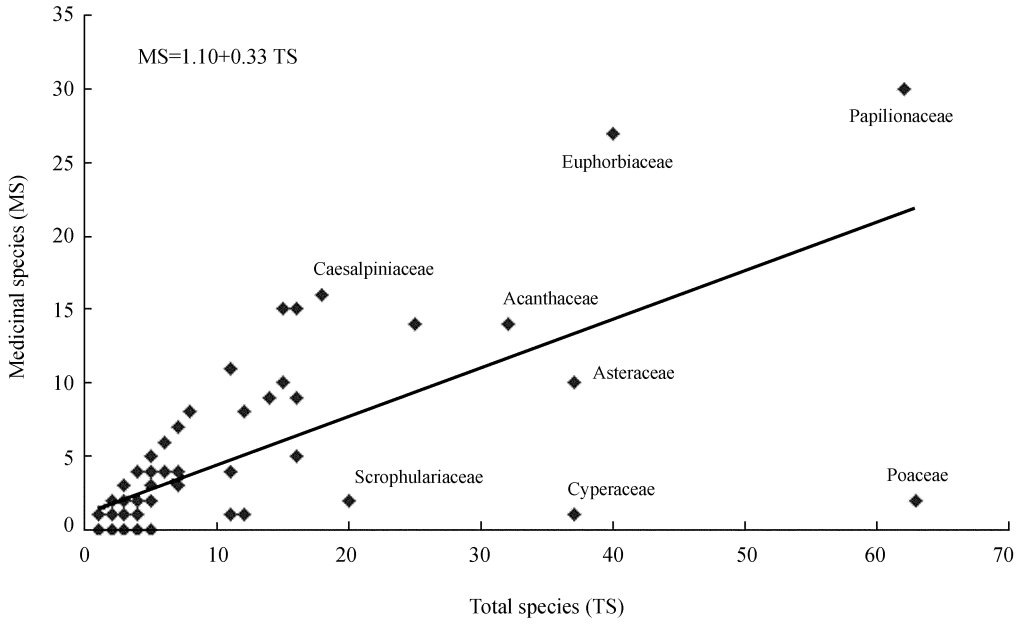

Fig. 2 Regression plot for 136 plant families in the Sambalpur flora, Orissa

Table 2 Points of differences in medicinal floras of different areas

	Jammu and Kashmir[a]	Similipahar[b]	Sambalpur
Family	106	138	136
Total species	739	1016	772
Medicinal species (%)	466 (64)	555 (54.6)	404 (52.3)
Non medicinal species (families)	0	19	30
Larger families	53 (F) 656 (TS) 400 (MS)	69 (F) 619 (TS) 445 (MS)	68 (F) 463 (TS) 347 (MS)
Smaller families	53 (F) 83 (TS) 66 (MS)	69 (F) 397 (TS) 110 (MS)	68 (F) 309 (TS) 57 (MS)

F: plant families; TS: total species; MS: medicinal species.
[a]Data from Kapur *et al.* (1992); [b]Data from Girach *et al.* (1999)

There are 106 plant families in the flora of Jammu and Kashmir with 739 species (Kapur *et al.*, 1992), 138 families in Similipahar region, while the flora of the Sambalpur were represented by 136 pant families. Among the floras of the Indian states, 64% of Jammu and Kashmir flora, 54.6% of Similipahar flora (Girach *et al.*, 1999) and 52.3% of Sambalpur flora are used medicinally (Table 2). Nineteen families of Similipahar flora and 30 families in Sambalpur flora have not represented any species used medicinally. But in Jammu and Kashmir, each of the 106 families produces at least one medicinally used species. In the flora of Sambalpur, among larger families 347 species are used medicinally out of 463 species, whereas only 57 species out of 309 species are used in smaller families. The data in Table 2 also reveal that contribution of smaller families as producers of species used in traditional medicines is hidden by the respective contribution of larger families.

There are some interesting similarities between the flora of Similipahar and the flora of Sambalpur. Seven families appear on the top in the list of high-use families in both the flora of Orissa: Euphorbiaceae, Papilionaceae, Rubiaceae, Verbenaceae (fourth in both cases), Cucurbitaceae, Caesalpiniaceae and Apocynaceae; whereas only two families (Euphorbiaceae and Amaranthaceae) are similar with flora of Jammu and Kashmir. These families have many species that are used medicinally in the two regions of Orissa. Four families occur in the bottom of the list in both regions: Poaceae, Cyperaceae, Orchidaceae and Scrophulariaceae. Poaceae, which

only rarely produces biologically active defensive chemicals and also the primary source of human staple foods, was also found last in the bottom of the list of Jammu and Kashmir flora (Kapur *et al.*, 1992). A few notable differences occur in the placement of families on these lists. Papilionaceae, Verbenaceae, Cucurbitaceae and Apocynaceae are primary sources of many medicines in Sambalpur (among the top 10 in the list), but are well down the list in Jammu and Kashmir on the 105th, 97th, 101st and 76th place respectively. Solanaceae, Asteraceae and Combretaceae which are found in top ten families in Similipahar flora, could not be found in Sambalpur flora.

The family Fabaceae includes three subfamilies, the Mimosoideae, the Caesalpinioideae and the Papilionoideae. These three subfamilies are reported as three distinct families in the three regions of India. In Jammu and Kashmir flora, Fabaceae family situated at 26th rank with 37 of its 69 species used medicinally (Kapur *et al.*, 1992). Combining the three families (Sambalpur flora) for comparison yields a group with 99 total species and 55 medicinal species. Applying the regression equation, this would give a predicted number of medicinal species of 33.7 with a residual value of 21.23. This family would be ranked 1st on Table 1. Critical analysis of Fabaceae (Papilionaceae) from the three regions of India is shown in Table 3. It shows some striking features in Papilionaceous floras of Jammu and Kashmir, Similipahar as compared to Sambalpur, as regards total species, medicinal species, altitude variation and ranking of family in all floras. From the Table 3, we can conclude that Fabaceae as a family is much more likely to be a source of medicines in Orissa, than that in Jammu & Kashmir.

Table 3 Striking features of Papilionaceae and Fabaceae in the floras of Jammu and Kashmir, Similipahar as compared to Sambalpur

Flora	Jammu and Kashmir①	Similipahar②	Sambalpur
Total species	56	75	62
Medicinal species	25	47	30
Altitude	700-3000 m	300-1166 m	300-985 m
Rank (Papilionaceae)	105	1	5
Rank (under concept of Fabaceae)③	26	1	1

① Data from Kapur *et al.* (1992); ② Data from Girach *et al.* (1999).
③ Fabaceae comprising Papilionaceae, Caesalpiniaceae and Mimosaceae

This method of data comparison allows us to identify: (a) plant families which represent substantial sources of traditional medicines (such as Euphorbiaceae, Rubiaceae, Malvaceae); (b) families with varying medicinal usage in different places (such as Papilionaceae, Cucurbitaceae, Verbenaceae); and (c) families which are apparently never substantial sources of traditional medicines (such as Poaceae, Cyperaceae). The comparison between the data of the three Indian regions shows that the Papilionaceae is on the top of high-use families in Similipahar flora; 5th rank in Sambalpur flora, while it is well below at (105th rank) in the flora of Jammu and Kashmir. The striking difference between the Papilionaceous flora of the two regions of India as shown in Table 3 may be attributed to the altitudinal variations, forest types and a large number of tribal communities, which have depended on their surrounding plant resources for their health care needs in the study area as compared to Jammu and Kashmir. But most important, this approach provides a theoretical context with which one may view and make sense of the mass of ethnobotanical data available in Sambalpur district and elsewhere. It provides a set of techniques by which one may stratify the data in order to select for close analysis taxa which may be more interesting than ones selected at random. These comparision can easily be extended to cover larger areas with the availability of floristic and ethnobotanical information of the regions.

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